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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/070,076	03/01/2002	Aritaka Ohno	KP0147	7254

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EXAMINER

LEE, HWA S

ART UNIT	PAPER NUMBER
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2877

DATE MAILED: 10/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/070,076

Applicant(s)

OHNO ET AL.

Examiner

Andrew H. Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☐ Claim(s) 1,2,4-7,10 and 11 is/are rejected.
- 7) ☐ Claim(s) 3,8 and 9 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 March 2002 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2,4. 6) ☐ Other:

DETAILED ACTION

Drawings

1. Figures 1 and 2 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

2. **Claims 1-11** are objected to because of the following informalities: Claims 1 and 4 recite a “second optical branch unit,” but does not recite a first optical branch unit. For examination purposes, it will be assumed that the “second optical branch unit” is a first optical branch unit.

3. **Claims 4, 5, and 7-11** are objected to because of the following informalities: Claim 4 recites a “second depolarizer” and a “third depolarizer” but does not recite a first depolarizer making claim 4 and its depending claims unnecessarily confusing. For examination purposes, the “second depolarizer” and the “third depolarizer” will be assumed as a first depolarizer and a second depolarizer respectively.

4. **Claim 9** is objected to because of the following informalities: Claim 9 has a misspelled the word “unit” as “unti” . Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. **Claims 10 and 11** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The claims are generally narrative and indefinite, failing to conform with current U.S. practice.

Claim 10 is drawn to an apparatus yet claims a method where “a separation is made” and then “are connected together.”

For examination purposes, claim 11 will be examined as if recited as:

“A current sensor using a Sagnac interferometer according to one of claims 1 to 7 in which a first connector, a first extended optical fiber, and a second connector connects the second branch unit to the first and a third connector, a second extended optical fiber, and a fourth connector connects the second branch unit to the second quarter-wave plate.

Claim 11 is vague and indefinite since claim 11 claims that there are two separations “made” in the interferometer, yet only claims that “either” of the separations are connected by the connects and extended optical fiber thus not clearly pointing out how the other separation is connected if at all.

For examination purposes, claim 11 will be examined as if recited as:

“A current sensor using a Sagnac interferometer according to one of claims 1 to 7 in which a first connector, an extended optical fiber, and a second connector connects the second branch unit to the first or second quarter-wave plate.”

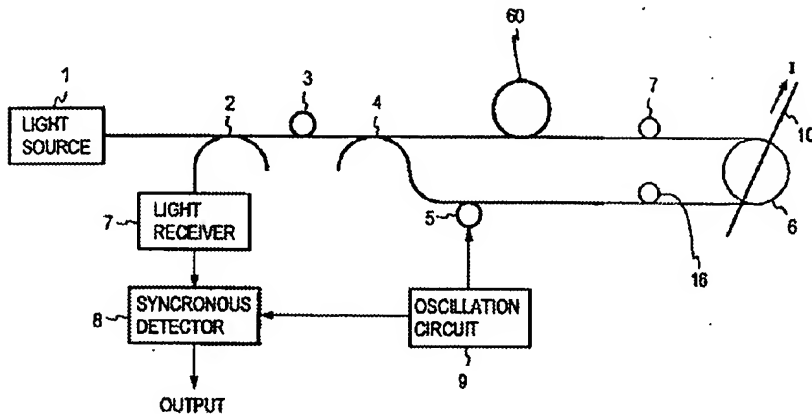
Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. **Claims 1 and 2** are rejected under 35 U.S.C. 103(a) as being unpatentable over the prior art disclosed by the applicant in view of Page et al (5,365,337).

As for claim 1, the prior art disclosed by the Applicant shows a current sensor using a Sagnac interferometer including a light source (1), an optical directional coupler (2) on which light from the light source impinges, a first polarization filter (3) on which light emitted from the optical directional coupler impinges and which emits a given linearly polarized light, a second optical branch unit (4) for branching light emitted from the first polarization filter into two beams, an optical phase modulator (5) connected to one branch end of the second optical branch unit, a current sensing coil (6) on which light from the other branch end of the second optical branch unit and light from the optical phase modulator impinge as levorotatory light and dextrorotatory light, a first quarter-wave plate (16) inserted between the optical phase modulator and the current sensing coil, and a second quarter-wave plate (7) inserted between the other branch end of the second optical branch unit and the current sensing coil.



The disclosed prior art does not show a first depolarizer inserted between the optical directional coupler and the first polarization filter.

Page et al (Page hereinafter) show a Sagnac interferometer using a depolarizer (202) in between the light source (200) and a polarization filter (210).

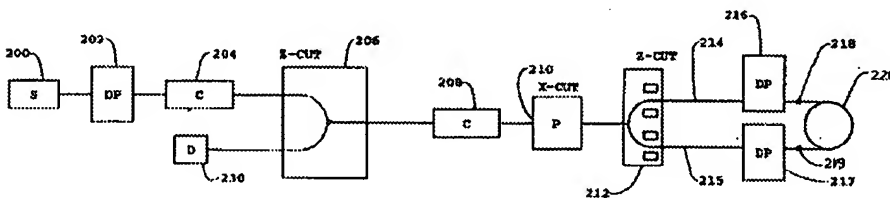


FIG. 2

At the time of the invention, one of ordinary skill in the art would have modified the Sagnac interferometer of the disclosed prior art with a first depolarizer inserted between the optical directional coupler and the first polarization in order to improve the efficiency of the first polarizing filter as taught by Page on column 2, lines 56+. Page teaches that a depolarizer with a polarizing filter improves the efficiency of the polarizing filter and that the placement of the depolarizer should be between the light source and the polarizing filter. Thus, suggesting to one of ordinary skill in the art that the criticality lies in that the light must be depolarized before entering the polarizing filter. Therefore, one of ordinary skill in the art would have placed the

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depolarizer anywhere in between the light source and the polarizing filter including placing the depolarizer immediately in front the polarizing filter which would place the depolarizer between the optical direction coupler and the polarizing filter in order to improve the efficiency of the polarizing filter.

As for **claim 2**, the disclosed prior art and Page show all of the claimed elements but do not show the additional depolarizer and polarization filter on the one branch end and the other branch end.

Page however shows a depolarizer and polarization filter in series and depolarizers on the one branch end and the other branch end. At the time of the invention, one of ordinary skill in the art would have used redundant depolarizers and polarization filters on one branch end and the other branch end. Page teaches that other optical elements in Sagnac interferometers such as beam splitters/recombiners and optical couplers repolarizes optical signals causing errors of the interferometer, thus suggesting to a skilled artisan that redundant depolarizers and polarization filters placed after error causing elements would further reduce the unwanted polarization changes. Therefore, one of ordinary skill in the art would have placed a redundant depolarizer and a polarization filter after the optical direction coupler in each optical branch of the prior art interferometer so that the interferometer is more accurate in its measurements. Furthermore, the skilled artisan would have placed one of the depolarizers and polarization filters after the optical phase modulator in order to removed unwanted polarization changes caused by the optical phase modulator.

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9. **Claims 4 and 5** are rejected under 35 U.S.C. 103(a) as being unpatentable over over the prior art disclosed by the applicant in view of Page as applied to claim 2 above, and further in view of Bennett et al (6,563,589).

The disclosed prior art and Page, as combined, show all of the claimed elements but do not show a light source that emits non-polarized light.

Bennett et al (Bennett hereinafter) show a Sagnac interferometer comprising a polarizer, coupler, $\frac{1}{4}$ wave plates, a coil, and a phase modulator wherein the light source is a light emitting diode.

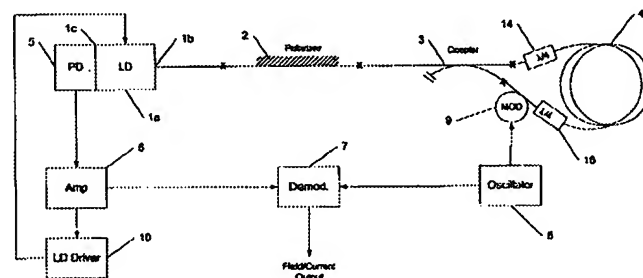


Fig. 1

At the time of the invention, one of ordinary skill in the art would have used a light emitting diode, which emits non-polarized light as disclosed by applicant, as the light source for the combined apparatus of the disclosed prior art and Page in order to provide light that is usable in the interferometer since Bennett teaches that light emitting diodes produce the proper type of light required in the Sagnac interferometer when used with a polarizer. Therefore, a skilled artisan would have used a non-polarizing light source in order to provide light to the interferometer.

As for **claim 5**, the disclosed prior art and Page show all the elements as described above, in addition to Page disclosing that the single mode optical fiber depolarizers have a group delay ratio of 2:1 in column 5 lines 21-32.

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10. **Claim 6** is rejected under 35 U.S.C. 103(a) as being unpatentable over the disclosed prior art and Page as applied to claim 2 above, and further in view of Sanders (6,301,400).

The disclosed prior art and Page show all the elements claimed including a first length adjusting optical fiber (60) but do not show a second length adjusting coil, the first and second length adjusting coils being wound in opposite directions from each other and disposed so that their center axes are substantially aligned on a common rectilinear line.

Sanders shows a current sensing Sagnac interferometer comprising a first (44) and second (43) length adjusting coils being wound in opposite directions from each other and disposed so that their center axes are substantially aligned on a common rectilinear line.

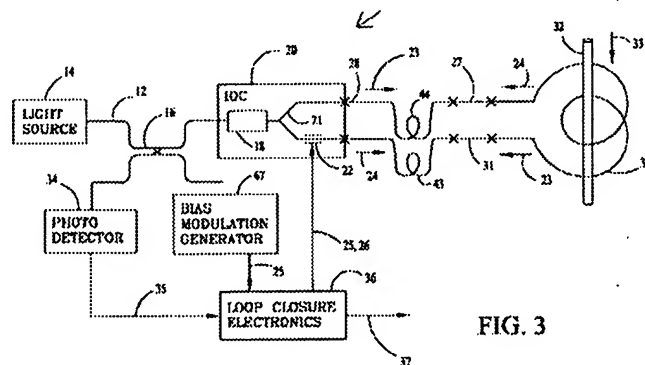


FIG. 3

At the time of the invention, one of ordinary skill in the art would have used a second length adjusting coil (43) being wound in opposite directions from the first adjusting coil (44) and disposed so that their center axes are substantially aligned on a common rectilinear line in order to null the rotation sensitivity of the first adjusting coil (column 3, lines 5-7) and thus have a current sensing Sagnac interferometer that is more accurate by eliminating a cause of error.

11. **Claim 7** is rejected under 35 U.S.C. 103(a) as being unpatentable over the disclosed prior art, Page, and Bennett as applied to claim 4 above, and further in view of Sanders.

The disclosed prior art, Page, and Bennett show all the elements claimed including a first length adjusting optical fiber (60) but do not show a first and second length adjusting coils being wound in opposite directions from each other and disposed so that their center axes are substantially aligned on a common rectilinear line.

Sanders shows a current sensing Sagnac interferometer comprising a first (44) and second (43) length adjusting coils being wound in opposite directions from each other and disposed so that their center axes are substantially aligned on a common rectilinear line.

At the time of the invention, one of ordinary skill in the art would have used a second length adjusting coil (43) being wound in opposite directions from the first adjusting coil (44) and disposed so that their center axes are substantially aligned on a common rectilinear line in order to null the rotation sensitivity of the first adjusting coil (column 3, lines 5-7) and thus have a current sensing Sagnac interferometer that is more accurate by eliminating a cause of error.

12. **Claims 10 and 11 as understood by the examiner** is rejected under 35 U.S.C. 103(a) as being unpatentable over the disclosed prior art and Page.

The disclosed prior art and Page show all the limitations as described above and Page further shows a optical waveguide connected in between the optical direction coupler and the second optical branch unit, and shows optical conductors (214) and (215), and also shows the use of optical fibers, but do not expressly say that the optical waveguide or optical conductor is an optical fiber. At the time of the invention, it would be obvious to one of ordinary skill in the art to use an optical fiber as the optical waveguide or optical conductor in order to direct light from one part of the interferometer to another part, and furthermore since Page teaches that the elements such as the optical direction coupler and second optical branch unit is connected, it

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there are connectors, whether the connections are spliced, permanent, or modular, on the ends of the optical fibers.

Allowable Subject Matter

13. **Claims 3, 8, and 9** are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

14. The following is a statement of reasons for the indication of allowable subject matter:

For **claim 3**, the prior art of record fails to show or to suggest a current sensor comprising of all the elements as presently claimed wherein the first depolarizer, the second depolarizer and the third depolarizer are formed by polarization maintaining optical fibers, the group delay time difference between orthogonal components of light occurring in each depolarizer being in the ratio greater than 1:2:4.

For **claim 8**, the prior art of record fails to show or to suggest a current sensor comprising of all the elements as presently claimed wherein the current sensing coil and the both length adjusting optical fiber coils satisfying the following inequality:

$$|R_c \times L_c - R_1 \times L_1 - R_2 \times L_2| < 5$$

where R_c : a mean radius of the current sensing coil

L_c : optical fiber length of the current sensing coil

R_1 : a mean radius of the first length adjusting optical fiber

L_1 : optical fiber length of the first length adjusting optical fiber coil

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R_2 : mean radius of the second length adjusting optical fiber coil

L_2 : optical fiber length of the second length adjusting optical fiber coil.

For **claim 9**, the prior art of record fails to show or to suggest a current sensor comprising of all the elements as presently claimed wherein an optical fiber which forms an optical path between one branch end of the second optical branch unit and the first quarter-wave plate and an optical fiber which defines an optical path between the other branch end of the second optical branch unit and the second quarter-wave plate are formed by single mode optical fibers having cut-off wavelengths which are by at least 100 nm longer than the wavelength of the light source.

Papers related to this application may be submitted to Technology Center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the PTO Fax Center located in CP4-4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The CP4 Fax Center numbers are 703-872-9306 for regular communications and for After Final communications

If the Applicant wishes to send a Fax dealing with either a Proposed Amendment or for discussion for a phone interview then the fax should:

a) Contain either the statement "DRAFT" or "PROPOSED AMENDMENT" on the Fax Cover Sheet; and

b) Should be unsigned by the attorney or agent.

This will ensure that it will not be entered into the case and will be forwarded to the examiner as quickly as possible.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew Hwa Lee whose telephone number is (703) 305-0538. The examiner can normally be reached on M-Th. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank Font can be reached on 703-308-4881.

A handwritten signature in black ink, appearing to read 'Andrew Lee', with a stylized, flowing script.

Andrew Lee
Patent Examiner
Art Unit 2877

September 21, 2003/ahl